CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S0615

Project Title

Effects of Temperature Variation in a Two Pot Synthesis of Polyol Using Benzoic Acid

Abstract

Objectives/Goals

Using vegetable oil to make polyurethane foam is gaining interest to make foam renewable and biodegradable. This research project is designed to test if polyol (a precursor of polyurethane) synthesis is possible using a plant based acid, benzoic acid. It also tests the effects of reaction condition variation in the efficiency of polyol formation.

Methods/Materials

The two-pot synthesis procedure involves two steps: epoxidation and the ring-opening step. Benzoic acid was used in the ring opening step. The reaction time and temperature was varied and the produced polyol was scanned through a Fourier Transform Infrared Spectrometer. The alcohol peak heights were then analyzed and interpreted as the amount of polyol formed.

Results

In contrast to previous papers, more polyol was formed at a lower temperature, i.e. 70 degrees Celsius, instead of 80 degrees. This suggests side reactions from the epoxide. More polyol was obtained in 3 hours than 5 hours at the same temperature, suggesting a continued reaction pathway of polyol. The polyol efficiency did not vary between 3-hour and 5-hour reaction times for 60 degrees Celsius.

Conclusions/Discussion

For the first time in polyol research history, this experiment showed that the production of polyol is possible through benzoic acid. It suggests that while benzoic polyol is the favored kinetic product under certain conditions, it is not the thermodynamic product. It also suggests that 70 degrees Celsius and 3 hours is the optimal reaction condition for the ring opening step, and that 60 degrees Celsius is below the energy threshold required to produce polyol. Such findings open possibilities for an entirely plant based foam using benzoic Acid.

Summary Statement

For the first time in research history, this experiment showed that the production of polyol is possible through benzoic acid, which opens up exciting possibilities for increased biodegradability of polyurethane foam.

Help Received

Jahan Dawlaty, Jonathan Ryan Hunt, Marissa Tessman, Peter Starodub, USC, UCSD